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WHEN THERE IS A DECLINE IN COGNITIVE FUNCTIONS, IS THERE A PLACE FOR MEDICAL REHABILITATION?

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Health is closely intertwined with the notions of autonomy, active life participation, and not just the absence of illness or disability. The specialty of Physical Medicine & Rehabilitation is concerned with the provision of the best rehabilitation practices in order to minimize the effects of a neurological deficit or disability. Dementia impacts a large scale of brain's functions (memory, thinking, recognition, reason, orientation, programming & personality). Statistics raise the population of people with dementia to 50 million people worldwide and confirm one new incident/3 sec.

The first sign is decreased interest in life and on the progression of the disease: 1st sense of time is lost, 2nd sense of place, 3rd recognition of familiar faces, finally severe diffuse amnesia is accompanied by a complete lack of orientation. The symptoms of dementia are different from those of normal memory decline due to age. Dementia's symptomatology leads to loss any capability of independent living.

Rehabilitation intervention is focused on prevention, correction, support, palliative care.

- Preventive rehabilitation: begins before/after diagnosing a life-limiting illness and attempts to mitigate the functional morbidity caused by the disease or its treatment.
- Correctional rehabilitation: aims to restore the person to their previous functional condition when functional impairment is limited (extent & time) and/or the patient maintains functional activity.
- Supporting rehabilitation: aims to maximize functionality when functional disorders have consequences of illness or injury - have increased and/or are not reversible.
- Palliative rehabilitation: aims to maintain a high quality of life to the best possible for the patient & the family who are dealing with a life-threatening critical illness by targeting the relief of symptoms (e.g. pain, dyspnea, edema) & the prevention of complications (e.g. contractures, ulcers).

Palliative care, according to the World Health Organization, is "applicable early in the course of the disease". The person does not need to be near the end of his life to be eligible for palliative care.

The measure of success of a compassionate palliative rehabilitation program must not focus on prolonging survival but on quality of life, functionality / independence & psychosocial well-being.

Ideally, rehabilitation services should be provided by an interdisciplinary team with a specialist rehabilitation coordinator. The team consists of a physiotherapist, occupational therapist/speech therapist, psychologist, nurse, nutritionist, psychotherapist, pharmacist, orthistist & case manager/social worker. The team can be joined by doctors of other specialties as needed (psychiatrist, pathologist, surgeon, dentist, etc.).

The interventions concern not only the patient, but his family, the environment, his caregivers & also the community. The key challenge is the transfer of skills from specialists to users (individual, family & community members) in the form of community based rehabilitation (C.B.R.). The aim is not extending survival, but on developing a system that will support the aging population and its new requirements.

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DEVELOPMENTS IN EARLY DIAGNOSIS AND MANAGEMENT OF ALZHEIMER'S DISEASE

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Introduction: Alzheimer's disease (AD) is the most common age-related neurodegenerative disease and the most common cause of dementia and Mild Cognitive Impairment (MCI) is the intermediate stage between normal ageing and dementia. About 15% of patients with amnestic MCI progress to AD after 1 year and about 80% after 7 years. The prevalence od dementia is 5-10% in population > 65 years and 30-40 in individuals >85 years old. The numbers are rising. Now it is estimated that 50 million people suffer from dementia worldwide and we are expected thios number to be .150 millions in 2050. In Greece we have more than 150.000 patients today.

Diagnosis: There are many screening tests for assessment the severity of dementia. MMSE is used mainly for screening dementia while Montreal Cognitive Assessment (MoCA) is used mainly for screening MCI with sensitivity 90% and specificity 87% to separate MCI from normal ageing. DemTect is another instrument with sensitivity 80% and specificity 92%. We have published a virtual Supermarket using the new technology and we found 82,35% sensitivity and 95,24% specificity[1]. New developments in Electroencephalogram, Magnetic Resonance Imaging and Positron Emission Tomography can help us in diagnostics of AD. Also specific proteins in blood (Amyloid β, inflammatory biomarkers etc) and Cerebrospinal fluid (Amyloid β, total tau, phospho tau) can be used as reliable biomarkers for early diagnosis.

Management: Today we use only symptomatic treatment (donepezil, rivastigmine, galantamine and memantine) for AD patients and there is no approved medication for patients with MCI. Unfortunately the last 16 years no new medication was approved. However, there are many ongoing clinical trials. The last years we try to use Greek natural products for management of patients with MCI. Crocus Kozanis was used, but also Early Harvest Extra Virgin Olive Oil with very promising results[2]. Also Nanotechnology may help us in future in every day clinical praxis.The most common NP formulations that have major impact in the diagnosis and therapy of AD include polymeric NPs (PPs), gold NPs, gadolinium NPs, selenium NPs, protein-based NPs, polysaccharide-based NPs, etc. Cognitive non pharmacological interventions either in correlation with new technologies or with pencil and paper can help also patients with MCI[3]. Body exercise and dancing is also a good therapeutic direction for patients with MCI[4].

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COGNITIVE EXERCISE IN ELDERLY PATIENTS WITH ALZHEIMER'S DISEASE: MYTH, REALITY OR A LUXURIOUS NEED?

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Cognitive loss is the first sign of possible development of dementia. Losing major cognitive abilities (e.g. memory) has detrimental effects on someone's sense of well-being and fear of threaten in his life. Directions in the treatment and rehabilitation of patients with Alzheimer's disease involve a medical intervention with questionable benefits and a behavioral one that aims to sustain the functionality of the patient as close as possible to his known way of life. This immediate non-pharmaceutical intervention for people with early signs of mild cognitive impairment or later stages of dementia is cognitive training which aims to improve basic cognitive functions (e.g., memory capacity, attention, executive functions), reduce the impact of dementia in everyday living, and in effect slow down the cognitive decline. We reviewed evidence that cognitive training is similar to the effect of physical training. The neuroplastic nature of the brain through repetitive cognitive practice engages healthy neural networks, promotes development through synaptic genesis and regrowth into new neural connections that contribute into the preservation of the functionality in the affected domain[1]. Examples of successful cognitive training programs come from simple paper and pencil tasks to more advanced practices with the use of Virtual reality, computer based tasks extending to art and dance activities[2]. Despite this ample evidence from various cognitive programs it remains unanswered the extent of the long-term effects of these interventions. There is evidence that a plethora of other factors determine the success of the cognitive intervention but overall it is statistically confirmed that the brain benefits from regular cognitive training. An intriguing observation that needs further investigation is the question

of what constitutes the ideal type of cognitive training? There are suggestions that learning will depend on the benefit a patient feels it has on his daily activities. It is argued that any new learning that goes hand in hand with promoting the feeling of survival of the organism by essentially targeting specific behavioral benefits (e.g. cooking) in learning the task is incorporated into the preserved aspects of a necessary behavior that sustains survival and thus the brain adopts it as a necessary one[3]. In conclusion, evidence argued that irrespective of the stage of the decline in the disease, cognitive training is not a luxury in the living of the patient, but contributes essentially to his quality of life and perhaps longevity. Nonetheless, longitudinal studies need to confirm this early observations if we are to aim for a successful holistic understanding of what it is to be considered as effective cognitive training and find a way to operationalize it in practice.

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OLDER AGE AND COGNITIVE IMPAIRMENT: NUTRITIONAL AND DIET RECOMMENDATIONS FOR PREVENTION AND MANAGEMENT

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Two are the most serious threats for the independence and the overall health of the persons older than 65, frailty and dementia. Preventing and managing the two conditions is a winning strategy for successful aging. Nutrition and diet are a core component of the abovementioned strategy because malnutrition remains one of the most serious health problems for older people worldwide and increases the risk for frailty and its consequences. When a health care professional approaches an elder is always advisable to screen for malnutrition with a validated tool such as the MNA (Mini Nutritional Assessment). Information's about nutritional efficacy can be collected with this approach, and appropriate individualized interventions can be planned. The BMI (Body Mass Index) that is part of the MNA approach can be a quick estimate of the Nutritional efficiency in calories. For over 65 years the most beneficial BMI seems to be 25 to 29.9, with less than 23 being at higher risk for augmented morbidity than the ones having BMI more than 30[1]. In parallel, chewing, swallowing and motility problems as well as depression, impaired cognition, and economic difficulties should be considered. There some evidence in the literature that the best strategy to prevent for malnutrition is the adoption of proven dietetic patterns like the Mediterranean and DASH (Dietary Approaches to Stop Hypertension) diet[2]. If needed the supplementation of nutrients should be considered. The best evidence for specific nutrients in preventing sarcopenia and frailty is a for a protein intake of 1.5 g/kg of body weight per day, type of protein is not yet clear even though there is some evidence for βHMB, arginine, lysine and whey protein. Strong evidence suggests also supplementation of vitamin D to an optimal level of 30 ng/ml as an essential component in older people to maintain muscle mass, attention note to overcorrect because it will have deleterious effects due to the incrementation of calcium in the brain[1]. Oxidative stress plays a central role in the initiation and progression of Alzheimer's disease, so antioxidants have been evaluated as a strategy against, the evidence though in the literature is not conclusive. Vitamin C and E have been related in vitro studies to a prevention of neural growth and hyperphosphorylation of Tau protein but the association between the dietary proteins and dementia risk are inconsistent. For omega-3 (ω3) there are RCTs studies to verify the effect of different concentrations of DHA and EPA on cognitive function in patients with mild deficits with inconsistent results[3]. Older people tend to have lower intakes of zinc a very important ionic signaling linked to Alzheimer's disease, the recommended range of intake are between 9.4 to 1.5 mg/day for men and 6.5 to 12 mg/day for women[4]. The link between low serum levels of B12 and folate in dementia are known and even though there is not clear evidence that dietary intake of B12 and folate can improve dementia supplementation is advised when there is deficiency[5].There is also strong evidence from metanalysis for energy and protein supplementation when diet is not enough to cover the needs of this vulnerable age spam[6]. Last adequate hydration and reduction of alcohol consumption is also part of a winning strategy in this age category[7].

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SAFE WALKING OF ELDERLY PATIENT WITH COGNITIVE IMPAIRMENT

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One full gait cycle begins at the heel strike of one foot and continues until the heel strike of the same foot in preparation for the next step. Changes in gait patterns with ageing have been described in previous studies and some typical decreased gait parameters are: gait speed, stride length, cadence step length, stride symmetry etc.[1]. Walking performance in older people is a useful clinical indicator predicting a variety of side effects, such as decreased mobility, falls, cognitive decline, and mortality. Together with frailty, slow walking speed is itself a widely used criterion in geriatric assessment and has become a good single estimator of frailty and its outcomes. A cut-off point at 0.8 m/s is established, and the European consensus on sarcopenia recommends measurement of muscle mass for anyone below this cut-off[2].

A distinct pattern in the associations between cognitive domains and gait domains was found: information processing speed was associated with rhythm, fine motor speed with tandem, and executive function was associated with pace, respectively. These results accentuate a relation between cognition and gait[3].

Cognitive decline or impairment is defined as objective evidence of impairment in cognitive domains: memory, executive function/attention, language, or visuospatial skills, essentially normal functional activities and absence of dementia[4]. A hypothesized relationship of cognitive decline with respect to the temporal course of decline in gait and cognition in ageing and neurodegenerative disease is already shown. Gait and cognition decline concurrently, this may occur in normal ageing - and explains evidence for reverse causality. The temporal nature of decline with age is unknown; it is unclear therefore if gait and cognition decline together or if one precedes the other in normal ageing[5].

Neural substrate (pathological change) underpins decline in cognition, but gait proves a more sensitive metric of cognitive change (due to role of cognition in gait) than global cognitive measures which are in common use. Common neural substrate with a different temporal course (pathology affects motor function prior to cognitive function), gait therefore declines prior to cognition[6].

A modern understanding suggests that cognitive impairment and gait abnormalities, as well as dementia and falls, are associated with each other as follows: gait abnormalities predict dementia and cognitive impairment increases falls risk[7].

Cognitive training studies were dominated by the ACTIVE trial. Moreover, physical interventions i.e. 6-months of virtual reality dance video game with treadmill walking combined with verbal memory training in adults over 70, exercise with an exercise and diet program; 6-months of an aerobic exercise program with stretching compared multicomponent physical activity with Tai Chi and many more have also been published as interventions of cognitive training on cognitive performance outcomes[8].

According to geriatric patients with cognitive impairment the use of assistive devices has risks and consequences. More research is needed on the safety and efficacy of devices in this population. The misuse of devices by cognitive impairment patients can be largely attributed to the fact that two thirds of patients use them without advice or even education from a health professional. The more complex the technology, the fewer older people with cognitive impairments can use it effectively, whether or not it is a device specifically designed for people with disabilities[9].

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THE ROLE OF VIRTUAL REALITY APPLICATIONS IN OLDER PATIENTS' EDUCATION SUFFERING FROM COGNITIVE IMPAIRMENT: A MYTH OR REALITY?

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Due to the increase of the average life expectancy, we become witnesses of a dramatic increase in aging-related disorders such as dementia. Dementia appears with a mental impairment, severe enough to disrupt Activities of Daily Living (ADLs). It is a multifaceted disorder that affects cognitive functions such as: memory, speech, higher brain functions for planning, organizing, prioritizing individual's activities.

Alzheimer's disease is the most common cause of dementia (approximately 60% of diagnosed cases), leading to cerebral cortex dysfunction initially in the hippocampus. Other causes of dementia are Vascular causes (e.g. stroke), Lewy Bodies, Korsakoff's Syndrome, Pick's Disease, Huntigton's Disease, Parkinson's Disease, Creutzfeld Jakob's Disease, AIDS, Brain Tumors, TBIs.

Other symptoms include: depression, confusion, aphasia and agitation, sleep disorders, aggression, inappropriate sexual behavior, incontinence, walking - falling disorders, incomplete orientation and/or hallucinations[1].

Hurd et al estimated in 2013 that dementia is among the most costly diseases in the Western world, with an annual cost of approximately $160 Billion. Costs are gradually increasing as the earth's population ages[2].

There is urgent need for technological innovation towards cognitive rehabilitation (assessment and intervention), cognitive activation and retraining, with cost-effective, accessible, flexible and inclusive interventions[4].

Research concerning brain plasticity of the in the elderly has overturned the belief that cognitive functions remain stable or diminished, and has highlighted the potential for interventions.

According to the ICF International Classification of Health and Disability, a problem of participation can arise when functional limitations (e.g. communication problems), meet affecting environmental factors that do not facilitate (barriers) individual's functioning.

Can Virtual Reality (VR) offer an alternative therapeutic intervention?

The application of VR for people with impaired cognitive functions, it is an innovation for cognitive re-education by using software to combine visual, auditory and tactile feedback simulating real environment that can be tailored to the needs of the specific population.

VR displays the ability to detect the external environment or digital ecosystem and provide adaptive capabilities in such a way, as to maximize the benefits to users (e.g. increased security), both as a diagnostic or recording, and as a tool of intervention. The earlier the process is diagnosed, the type and stage of the disease, the stronger the role of early intervention, which can potentially minimize the onset of neurodegeneration, optimizing functioning and even quality of life.

VR has the potential to improve the reliability, sensitivity, specificity and validity of cognitive assessment by enabling precise control and management of stimuli. It has emerged as a very promising tool for treatment and rehabilitation, of the elderly suffering from mental disorders such as dementia. By creating smart cities or cybervilles, their implementation of dementia care looks promising as it could delay the need for long-term care and institutionalization, thereby reducing the cost of care significantly, while improving quality of life. Technology-assisted care does not replace human care, but complements it.

Despite great enthusiasm and significant biomedical efforts, the treatment for dementia remains elusive. VR has significant potential to empower people with dementia and reduce care costs. However, if and since individuals suffering from dementia and their caregivers are to benefit from these developments, significant efforts are needed to develop and evaluate the applications of VR for cognitive assessment and rehabilitation, therapeutic activity and immersion as well as planning[5].

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